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Lathyro asphodeloidis-Klaseetum lycopifoliae, a new plant association in the alliance *Cynosurion cristati* Tüxen, 1947 in Central Apennines

Giampiero Ciaschetti[1], Gianfranco Pirone[2]

1 *Majella National Park, Via Badia 28, I-67039 Sulmona, Italy* **2** *Department of Life Health and Environmental Sciences, University of L'Aquila, Via Vetoio, Coppito, I -67100 L'Aquila, Italy*

Corresponding author: *Giampiero Ciaschetti* (giampiero.ciaschetti@parcomajella.it)

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Abstract

This study presents a new plant association discovered in the Central Apennines and named *Lathyro asphodeloidis-Klaseetum lycopifoliae*. It consists of a semi-natural meadow characterized by the co-dominance of two rare taxa, *Klasea lycopifolia* and *Lathyrus pannonicus* subsp. *asphodeloides*, occurring in Italy in only a few localities in the Central and Northen Apennines. The association was discovered on the Altopiano delle Rocche high plateau in the province of L'Aquila (Abruzzo region, Italy).

Multivariate analysis of the relevés shows two floristic and ecological aspects, corresponding to two different subassociations: *festucetosum circummediterraneae*, with elements from the *Festuco-Brometea* class, growing in the outer portions of the plateau, and *narcissetosum poëtici*, corresponding to the most typical aspect and occupying the central part of the plateau, differentiated by meso-hygrophilous species of the *Molinietalia* and *Trifolio-Hordeetalia* orders.

The plant association has great natural value, due to the presence of several rare plant species, and cultural importance in association with the traditional "Narcissus Fest" held each year in May.

Keywords

Klasea lycopifolia, Hay meadows, Sirente-Velino Regional Park, Abruzzo

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Introduction

The herbaceous vegetation of the high karst plateaus in the Central Apennines has been the subject of a number of studies (e.g. Cortini Pedrotti et al. 1973; Pedrotti 1976, 1982a, 1982b, 1985; Pedrotti et al. 1976, 1992; Pedrotti and Cortini Pedrotti 1982; Biondi et al. 1999; Pirone 1987a, 1997; Venanzoni 1992; Ciaschetti et al. 2006; Blasi et al. 2012), but an exhaustive picture of the plant associations present in these environments has not yet been clearly defined.

In particular, although studied since the 1960s (e.g. Pedrotti 1963, 1967, 1976; Cortini Pedrotti et al. 1973), the syntaxonomic interpretation of the humid meadows still presents numerous difficulties, particularly with respect to the lower hierarchical levels. Setting aside the marshy aspects and those developing on regularly flooded land, corresponding to the *Phragmito-Magnocaricetea* and *Agrostietea stoloniferae* phytosociological classes and the *Molinietalia* and *Trifolio-Hordeetalia* orders, a number of associations and communities have been described in the Central Apennines in the *Arrhenatheretalia* and *Trifolio-Phleetalia* orders (Pedrotti 1963; Bruno and Covarelli 1968; Cortini Pedrotti et al. 1973; Ubaldi 1978; Biondi and Ballelli 1982, 1995; Biondi et al. 1989; Pedrotti et al. 1992; Venanzoni 1992; Francalancia et al. 1995; Baldoni et al. 1996; Blasi et al. 1998, 2009; Lombardi et al. 2000; Taffetani 2000; Angiolini et al. 2001; De Dominicis et al. 2001; Viciani et al. 2002a, 2002b; Allegrezza 2003; Biondi et al. 2004; Catorci et al. 2007; Allegrezza and Biondi 2011).

This study presents a new type of humid meadow, with a physiognomy characterized by the dominance of *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve, a very rare member of the Asteraceae family with a W-C-Pontic SE-Sarmatic distribution and Pannonic, W-Illyrian and W-Alpine disjunct populations (Conti and Manzi 1997). Very rare throughout Italy, the species is present in just nine sites in Abruzzo, Emilia-Romagna, Umbria and Marche (Gigante et al. 2014). It was indicated for the first time in Italy in the Sirente-Velino Regional Park where it is present in four different sites (Conti and Manzi 1997; Ciaschetti 2003; De Santis and Soldati 2011).

In Italy, *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve grows in various types of environment, ranging from steppe-continental xeric meadows to mesophilous meadows in montane and sub-alpine zones (Gigante et al. 2014). In the hay meadows on the Altopiano delle Rocche high plateau, *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve is clearly dominant in the vegetation described here.

Included among the endangered species on the Italian Red List (Rossi et al. 2013) and as a priority species in Annex II of the Habitat Directive, *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve is the subject of a Life project aimed at safeguarding and valorizing seven species of European interest in three national parks in the Central Apennines (Di Martino et al. 2016).

Lathyrus pannonicus (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler, a rare sub-species with a South-European distribution, is abundant in the studied vegetation. In Italy it is present only in Lazio, Abruzzo and Molise, while it is doubtful in Basilicata and Calabria (Bartolucci et al. 2018c).

Study area

The study area (Suppl. material 1: 1) corresponds to the Altopiano delle Rocche high plateau in the Sirente-Velino Regional Nature Park, L'Aquila province, Abruzzo region. In particular, the study considers the northernmost part of the high plateau, between the villages of Rocca di Mezzo, Rocca di Cambio and Terranera (42°13.85'N, 13°31.05'E). This consists of a vast "*polje*" type plain of tectonic-karst origin, once site of an ancient lacustrine basin, at a mean altitude of 1350 a.m.s.l. It is bordered to the north and west by Monte Cagno (2153 m a.m.s.l.), Forcamiccia (1909 m a.m.s.l.) and Monte Rotondo (2060 m a.m.s.l.), and to the east by a series of lower elevations including the Monti della Cerreta (1510 m a.m.s.l.), Colle Jannini (1432 m a.m.s.l.) and Monte Grilletti (1361 m a.m.s.l.), separating it from the Subequana Valley.

To the south, the high plateau extends beyond the village of Rocca di Mezzo as far as Ovindoli and the Arano Valley.

The majority of the plateau is occupied by Holocene lacustrine sediments overlaid by deep sometimes hydromorphic soils with an A-B-C- profile, with fine to moderately fine texture, almost no stony surface cover and a low skeleton content, generally decarbonated and with a slightly acid surface reaction, gradually progressing to neutral with depth (Vannicelli Casoni 1999).

To classify the climate, thirty years of data from the nearby precipitation and temperature station of Rocca di Mezzo (1329 a.m.s.l.) were analysed and used to construct the ombrothermic diagram (Suppl. material 1: 2). Analysis of the data showed the winter cold to be a significant characteristic of the area, with minimum temperatures below 0 °C for five months and mean temperatures below 10 °C for seven months. There is no summer aridity and near semi-arid conditions as defined by Rivas-Martínez (2011), i.e. $P \leq 2.5T$, occur only in July. According to the Rivas-Martínez bioclimatic classification (2011), the area can be classified in the sub-Mediterranean variant of the oceanic temperate bioclimate, upper supra-temperate thermotype, upper humid ombrotype.

The vegetation of the study area is mowed once a year, usually at the end of July, and only occasionally it is grazed by a few animals after mowing. For details on management and its implications on flora composition, see Giallonardo et al. (2019).

Material and methods

The vegetation under study was analysed using the classical phytosociological method of the Zurich-Montpellier sigmatist school (Braun-Blanquet 1964). The abundance-dominance indices were transformed by numerical processing according to the scale proposed by Van der Maarel (1979). The matrix of 77 species × 15 relevés thus obtained was cleaned of the companion species present in just one relevé and then processed using the multivariate analysis techniques in the SYNTAX-2000 package (Podani 2001). In particular, cluster analysis was performed using the chord distance as

Table 1. Phytosociological table (FES = *Festuco-Brometea*; GER = *Trifolio-Geranietea sanguinei*; MOL = *Molinio-Arrhenatheretea*; BUL = *Poetea bulbosae*; NAR = *Nardetea strictae*; ART = *Artemisietea vulgaris*; MUL = *Mulgedio-Aconitetea*; PHR = *Phragmito-Magnocaricetea*; EPI = *Epilobietea angustifolii*; SAC = *Stipo giganteae-Agrostietea castellanae*; SES = *Elyno-Seslerietea*).

	Relevé no.	**1***	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12***	**13**	**14**	**15**
	Aspect	NNE	NNE	NNE	-	-	-	-	-	-	-	-	-	-	-	-
	Slope (°)	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
	Area (sm)	50	60	60	70	100	100	100	80	100	100	120	100	100	100	100
	Coverage (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
***Lathyro asphodeloidis*-Klaseetum *lycopyfoliae* ass. nova**																
FES, GER	*Klasea lycopifolia* (Vill.) Á.Löve & D.Löve	2	2	3	2	3	2	4	2	3	5	4	3	4	2	3
MOL	*Lathyrus pannonicus* (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler	1	2	2	2	3	2	3	2	3	1	3	3	.	2	1
FES	*Centaurea jacea* L. subsp. *gaudinii* (Boiss. & Reut.) Gremli	+	+	+	.	2	1	1	2	+	.	.	1	.	.	2
***festucetosum circummediterraneae* subass. nova**																
FES	*Festuca circummediterranea* Patzke	2	3	3	3	.	.	.	.	.	.	.	.	.	.	.
BUL	*Poa bulbosa* L. subsp. *bulbosa*	2	3	3	3	.	.	1	.	.	.	.	.	.	.	.
FES	*Astragalus danicus* Retz.	1	1	1	1	.	.	+	.	.	.	.	.	.	.	.
NAR	*Podospermum canum* C.A.Mey.	2	+	1	1	+	.	.	.	.	.	.	.	.	.	.
FES, BUL, ART	*Medicago lupulina* L.	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.
FES	*Veronica orsiniana* Ten.	.	1	+	.	+	.	.	.	.	.	.	+	.	.	.
FES	*Bromopsis erecta* (Huds.) Fourr. subsp. erecta	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
***narcissetosum poëtici* subass. nova**																
MOL	*Narcissus poëticus* L.	.	+	.	.	3	3	2	2	3	2	3	2	+	3	2
MOL, MUL	*Rumex acetosa* L. subsp. *acetosa*	.	.	.	.	+	+	1	1	1	+	1	+	1	1	1
MOL, MUL	*Ranunculus marsicus* Guss. & Ten.	.	.	.	.	1	2	.	1	2	1	1	1	1	2	1
MOL	*Bistorta officinalis* Delarbre	.	1	.	+	.	3	1	2	2	.	2	2	2	2	3
FES	*Tulipa pumila* Moench	.	.	.	.	2	.	2	.	.	1	+	1	+	.	.
MOL	*Bromus racemosus* L. subsp. *racemosus*	.	.	.	.	+	1	1	2	+	1	.	1	1	.	.
PHR	*Myosotis scorpioides* L. subsp. *scorpioides*	.	.	.	.	.	+	.	.	1	.	.	+	+	1	+
MOL	*Lychnis flos-cuculi* L. subsp. *flos-cuculi*	.	.	.	.	.	.	.	+	1	1	+	+	.	.	+
Cynosurion cristati																
BUL, MOL	*Bellis perennis* L.	.	.	.	.	.	.	.	+	+	+	+	1	+	.	+
BUL, MOL	*Cynosurus cristatus* L.	.	.	.	.	1	.	+	+	+	.	.	.	.	.	.
MOL	*Trifolium repens* L.	.	.	.	+	+	.	.	.	.	.	.	.	.	1	+
MOL	*Veronica serpyllifolia* L.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	1
MOL	*Scorzoneroides autumnalis* (L.) Moench	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.
Upper units																
MOL	*Alopecurus pratensis* L. subsp. *pratensis*	.	2	+	1	+	3	1	4	3	2	3	3	3	4	2
MOL	*Taraxacum* sect. *Taraxacum*	1	+	1	+	1	2	.	1	1	1	+	1	+	1	.
MOL	*Trifolium pratense* L. subsp. *pratense*	1	1	1	+	.	.	2	2	1	2	2	2	1	1	2
MOL	*Cerastium holosteoides* Fr.	1	2	2	1	.	.	1	+	1	+	+	.	1	.	2

	Relevé no.	1*	2	3	4	5	6	7	8	9	10	11	12*	13	14	15
MOL	*Ranunculus acris* L. s.l.	.	.	.	+	+	2	.	2	3	+	1	1	+	2	2
BUL	*Anthoxanthum odoratum* L.	.	.	.	.	1	1	1	1	2	1	1	1	1	1	1
MOL	*Lathyrus pratensis* L. subsp. *pratensis*	.	3	2	1	.	.	1	+	1	.	1	1	.	.	1
MOL	*Rhinanthus minor* L.	+	.	.	.	.	.	.	1	1	1	1	2	+	+	.
FES, MOL	*Leontodon hispidus* L. subsp. *hispidus*	.	.	.	.	2	.	+	+	.	1	1	.	1	+	.
MOL	*Lotus corniculatus* L. subsp. *corniculatus*	1	1	1	1	1	.	+	.	.	.	.	.	.	.	.
MOL	*Colchicum lusitanum* Brot.	.	+	.	+	.	+	.	+	.	+	.	.	.	.	.
MOL	*Poa pratensis* L. subsp. *pratensis*	.	.	.	.	+	.	2	.	.	.	.	.	1	.	1
FES, MOL	*Ranunculus polyanthemoides* Boreau	.	.	.	.	.	.	.	.	.	1	2	2	2	.	.
ART, MOL	*Achillea millefolium* L. subsp. *millefolium*	2	.	1	1	.	.	.	.	.	.	.	.	.	.	.
MOL	*Carex distans* L.	.	.	.	+	.	.	.	+	.	.	.	.	.	1	.
MOL	*Leucanthemum vulgare* (Vaill.) Lam. subsp. *vulgare*	.	.	.	.	+	.	.	.	+	.	.	.	.	.	+
GER, MOL	*Galium mollugo* L.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+
MOL	*Sanguisorba officinalis* L.	.	.	.	.	2	+	.	.	.	.	.	.	.	.	.
MOL, NAR	*Serratula tinctoria* L. subsp. *tinctoria*	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.
MOL	*Agrostis stolonifera* L. subsp. *stolonifera*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
EPI, MOL	*Valeriana officinalis* L. subsp. *officinalis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Other species																
FES, GER	*Galium verum* L. subsp. *verum*	1	1	1	1	2	1	1	1	1	3	2	2	2	1	3
FES	*Ranunculus bulbosus* L.	+	3	3	2	.	.	+	1	+	.	.	+	+	+	.
FES	*Anacamptis morio* (L.) R.M.Bateman, Pridgeon & M.W.Chase	.	+	.	.	1	.	1	.	+	1	1	1	+	.	.
FES	*Filipendula vulgaris* Moench	.	.	.	.	2	2	2	.	1	2	3	2	.	2	.
FES, NAR, SAC	*Luzula campestris* (L.) DC. subsp. *campestris*	.	.	.	.	+	.	+	+	+	+	1	1	1	.	.
MOL	*Euphorbia gasparrini* Boiss. subsp. *samnitica* (Fiori) Pignatti	+	.	.	.	+	.	2	.	.	1	.	1	.	.	.
FES	*Saxifraga bulbifera* L.	.	.	.	.	.	.	+	1	+	+	+	.	1	.	+
FES, MOL	*Plantago media* L. subsp. *media*	1	+	1	1	.	.	.	.	.	.	.	.	.	.	+
FES	*Knautia calycina* (C.Presl) Guss.	+	+	+	.	.	.	+	.	.	.	.	+	.	.	.
MOL	*Potentilla reptans* L.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	+
EPI	*Cruciata laevipes* Opiz	.	+	.	+	.	.	.	.	.	.	.	.	2	.	2
MOL	*Ajuga reptans* L.	.	.	.	.	.	.	.	.	.	1	+	1	+	.	.
MOL	*Dactylis glomerata* L. subsp. *glomerata*	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.
SES	*Poa alpina* L. subsp. *alpina*	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.
FES	*Muscari neglectum* Guss. ex Ten.	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.
ART, SES	*Cerastium arvense* L. subsp. *arvense*	1	.	.	.	.	.	.	.	.	.	.	+	.	.	.
FES	*Ranunculus millefoliatus* Vahl	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.
ART, MOL	*Rumex obtusifolius* L. subsp. *obtusifolius*	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
Sporadic species		3	0	0	1	2	1	3	0	0	0	0	1	1	1	2

the correlation coefficient and average linkage as the clustering strategy. Several ordinations (PCA, PCoA, NMDS) were carried out to confirm the validity and separation of the clusters identified.

A further PCoA was performed on the synoptic table built with the original tables of all the associations attributed by Blasi et al. (2012) to the suballiance *Cerastio arvensis-Cynosurenion*, plus the table presented here. The chord distance was used as dissimilarity coefficient.

The nomenclature follows the updated checklist of the vascular flora native to Italy (Bartolucci et al. 2018a, 2018b, 2018c), while the syntaxonomic classification follows the Prodrome of Italian Vegetation (Biondi et al. 2014).

The diagnostic species of the classes in Table 1 follow Mucina et al. (2016), with the exception of *Tulipa pumila* Moench (Aeschimann et al. 2004) and *Euphorbia gasparrini* Boiss. subsp. *samnitica* (Fiori) Pignatti (no data available, our own interpretation). For species in the *Cynosurion* alliance and *Trifolio-Phleetalia* order, reference was made to the Italian Vegetation Prodrome (Biondi et al. 2014).

Results

The studied vegetation is to be framed in the *Cynosurion cristati* alliance, as shown in Table 1. Regarding to the two sub-alliances identified in Central Italy (Blasi et al. 2012), the geographical, environmental and floristic features of this vegetation, together with the low presence of annual and Mediterranean species, led us to refer it to the *Cerastio arvensis-Cynosurenion* sub-alliance described for Central-Northen Apennines (Blasi et al. 2012).

The PCoA performed on the synoptic table built with all the associations attributed by Blasi et al. (2012) to this sub-alliance highlights the autonomy of the studied vegetation by putting it in a clearly separate space with respect to the others (Suppl. material 1: 3).

The hierarchical classification of the relevés (Suppl. material 1: 4) clearly highlights the distinction of two clusters within the described vegetation, also confirmed by several ordinations performed (PCA, PCoA, NMDS) but not presented here.

Discussion

The studied vegetation differs considerably from all the associations described in the *Cynosurion cristati* alliance for the Central Apennines (Bruno and Covarelli 1968; Cortini-Pedrotti et al. 1973; Pedrotti et al. 1976; Ubaldi 1978; Biondi et al. 1989; Pedrotti et al. 1992; Biondi and Ballelli 1995; Blasi et al. 2009), mainly for its particular physiognomy, represented by *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve and *Lathyrus pannonicus* (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler, both very rare species in Abruzzo and Italy (Conti 1998; Gigante et al. 2014; Bartolucci et al. 2018c).

The various associations and groupments that were attributed to the *Cynosurion cristati* alliance in Central Italy show very varied physiognomies, but no communities had been ever described with such abundant *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve and *Lathyrus pannonicus* (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler. Apart from *Cynosurus cristatus* L. (e.g. Cortini Pedrotti et al. 1973; Pedrotti et al. 1992; Biondi et al. 1989; Biondi and Ballelli 1995; Francalancia et al. 1995; Blasi et al. 1998, 2009; Viciani et al. 2002a, 2002b; Allegrezza 2003; Biondi et al. 2004; Pirone et al. 2005; Catorci et al. 2007) several other species are dominant in the phytosociological tables. The most frequent are *Lolium perenne* L. (e.g. Bruno and Covarelli 1968; Venanzoni 1992; Francalancia et al. 1995; Pedrotti 2008; Blasi et al. 2009), and *Poa trivialis* L. (e.g. Cortini Pedrotti et al. 1973; Venanzoni 1992; Biondi and Ballelli 1995; Pedrotti 2008; Blasi et al. 2009), while less frequent are *Holcus lanatus* L. (Biondi et al. 1989; Venanzoni 1992; Lombardi et al. 2000), *Dactylis glomerata* L. (Lombardi et al. 2000; Blasi et al. 2009), *Festuca rubra* L. s.l. (Lorenzoni et al. 1983; Biondi et al. 1989; Francalancia et al. 1995), *Ononis spinosa* L., *Genista tinctoria* L. or *Nardus stricta* L. (Lorenzoni et al. 1983), *Festuca circummediterranea* Patzke (Francalancia et al. 1995, Allegrezza 2003), *Lolium pratense* (Huds.) Darbysh. (= *Festuca pratensis* Huds.) (Francalancia et al. 1995), *Anthoxanthum odoratum* L. (Cortini Pedrotti et al. 1973; Pedrotti et al. 1992; Blasi et al. 2009), *Bromopsis erecta* (Huds.) Fourr. (Biondi et al. 1989); *Bromus hordeaceus* L. (Allegrezza 2003; Blasi et al. 2009), *Poa pratensis* L. subsp. *pratensis* (Francalancia et al. 1995; Blasi et al. 2009), *Trifolium repens* L. (Cortini Pedrotti et al. 1973), and *Trifolium pratense* L. subsp. *pratense* or *Rhinanthus minor* L. (Pedrotti et al. 1992).

Even if the framing of the studied vegetation is to be in the *Cynosurion alliance* and in the *Cerastio arvensis-Cynosurenion* sub-alliance, this vegetation does not spread far from the altitudinal and ecological limits of the alliance, with some affinities with the communities of the *Ranunculion velutini* alliance with which it is in topographical contact (Suppl. material 1: 5).

The studied vegetation also differs considerably from those described for the nearby Piano di Pezza (Ciaschetti et al. 2006) which is located at a higher altitude and only grazed.

All these differences led us to propose a new association with the name of *Lathyro asphodeloidis-Klaseetum lycopifoliae* (typus rel. 12, Table 1) in the *Cynosurion cristati* alliance. At suballiance level, it is to be classified in the *Cerastio arvensis-Cynosurenion cristati* suballiance described by Blasi et al. (2012) for the Central-Northern Apennines.

Consisting of four relevés, the cluster I of the dendrogram (Suppl. material 1: 4) refers to the more xeric aspects of the association prevailing in the outermost areas of the plain characterized by lower edaphic humidity. These aspects are differentiated by a contingent of species characteristic of xeric and semi-mesophilous secondary pastures of the *Festuco-Brometea* class, such as *Festuca circummediterranea* Patzke, *Poa bulbosa* L. subsp. *bulbosa*, *Astragalus danicus* Retz., *Podospermum canum* C.A.Mey., *Medicago lupulina* L., *Veronica orsiniana* Ten. and *Bromopsis erecta* (Huds.) Fourr. subsp. *erecta*. This group of relevés corresponds to the subassociation *festucetosum circummediterraneae* (typus: rel. 1, Table 1).

The second group (cluster II) corresponds to the typical and widespread aspect of the association (Suppl. material 1: 4), characterizing a large part of the central and lowest-lying portion of the high plateau. As well as *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve and *Lathyrus pannonicus* (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler, also contributing to the physiognomy are *Narcissus poëticus* L., *Bistorta officinalis* Delarbre and *Alopecurus pratensis* L. subsp. *pratensis*. Respect to the first cluster, the floristic composition shows a greater abundance of species belonging to the *Molinio-Arrhenatheretea*, such as *Anthoxanthum odoratum* L. subsp. *odoratum*, *Ranunculus acris* L. s.l., *Leontodon hispidus* L. subsp. *hispidus, Rumex acetosa* L. subsp. *acetosa*, etc. The typical subassociation *narcissetosum poëtici* is differentiated by *Narcissus poëticus* L., *Ranunculus marsicus* Guss. & Ten., *Bistorta officinalis* Delarbre, *Tulipa pumila* Moench, *Bromus racemosus* L. subsp. *racemosus*, *Myosotis scorpioides* L. subsp. *scorpioides* and *Lychnis flos-cuculi* L. subsp. *flos-cuculi*.

The position of the two subassociations along a sequence following a water-soil gradient in the plateau is shown in suppl. material 1: 5.

The new association shows a particular floristic composition with the low presence or absence of some characteristic species of the *Cynosurion* alliance, such as *Lolium perenne* L., *Phleum pratense* L. subsp. *pratense*, *Phleum nodosum* L., *Scorzoneroides autumnalis* (L.) Moench and *Veronica serpyllifolia* L. On the other hand, probably due to less disturbance by grazing cattle, it includes several rare species, making this vegetation important from a conservation point of view:

Klasea lycopifolia (Vill.) Á.Löve & D.Löve [= *Serratula lycopifolia* (Vill.) A.Kern.]
In Italy, according to Gigante et al. (2014) and Bartolucci et al. (2018c) this species occurs in Emilia-Romagna, Umbria, Marche and Abruzzo. In the latter region, it is indicated for the localities of Le Prata and Campo di Rovere on the Altopiano delle Rocche (Conti and Manzi 1997; Ciaschetti 2003), Prati del Sirente (Ciaschetti 2003) and Campo Felice (De Santis and Soldati 2011). It is listed as a priority species in Annex II of the Habitat Directive and included in Category 1 (Extremely rare or endangered species, or species with a very small population, exclusive or at the limit of their distribution area and known for few point localities) in Conti and Bartolucci (2012).

Lathyrus pannonicus (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler
In Italy, according to Bartolucci et al. (2018c) this taxon is certainly known only for Abruzzo, Lazio and Molise. It is found on the main tectonic-karst high plateaus in Abruzzo (Tenore 1831–42; Pedrotti 1969; Tammaro 1971; Anzalone and Veri 1975; Pignatti 1982, 2017; Pirone 1987b; Conti 1992b; Conti 1998; Conti and Bartolucci 2016). The population growing in Altopiano delle Rocche was recently analysed also from a molecular and karyological (2n = 14) point of view (Schlee et al. 2011; Peruzzi et al. 2016) and needs further studies.

It is listed as a priority species in Annex II of the Habitat Directive, indicated as Vulnerable (VU) in the Regional Red List of Endangered Flora (Conti et al. 1997) and included in Category 1 (Extremely rare or endangered species, or species with a very small population, exclusive or at the limit of their distribution area and known for few

point localities) in the List of Plants of Conservation Interest in Abruzzo (Conti and Bartolucci 2012).

Astragalus danicus Retz.
Species with a Central European – South Siberian distribution area (Pignatti 2017), at its southernmost limit in the Central Apennines. In Abruzzo, it is indicated for the Abruzzo, Lazio and Molise National Park (Conti and Bartolucci 2015), Sirente-Velino Regional Park (Tammaro 1971; Lucchese and Lattanzi 1991; Dinter 1996) Monte Rotella (Petriccione 1986), Piano Aremogna (Conti 1998), Piano delle Cinquemiglia (Conti 1995), Palena at Colle Fauno (Ciaschetti et al. 2015), Monte Focalone (Dinter 1996) and Passo San Leonardo (pers. obs.).

It is protected by the Regional Law for the Protection of Spontaneous Flora (Abruzzo Regional Laws 45/79 and 66/80) and is included as a species at low risk (LR) in the Regional Red List of Endangered Flora (Conti et al. 1997).

Euphorbia gasparrini Boiss. subsp. *samnitica* (Fiori) Pignatti
Taxon endemic to the Central Apennines (Peruzzi et al. 2014; Cresti et al. 2019). In Abruzzo, it occurs in just a few localities (Basile et al. 1970; Tammaro and Veri 1971; Pignatti 1982; Tammaro 1986, 1995; Pirone 1987b; Conti 1992a; Conti 1998; Conti and Bartolucci 2015, 2016).

According to the IUCN criteria, is evaluated as Least Concern (LC; Orsenigo et al. 2018) and included in Category 2 (Endemic but not endangered species) in the List of Plants of Conservation Interest in Abruzzo (Conti and Bartolucci 2012).

Ranunculus marsicus Guss. & Ten.
Species endemic to the Central Apennines, occurring from the Gran Sasso massif to the Monti della Meta (Dunkel 2011).

It is evaluated as Data Deficient (DD; Orsenigo et al. 2018) and included in Category 0 (Extremely rare or endangered species, or species with a very small population, exclusive or at the limit of their distribution area and known for few point localities) in the List of Plants of Conservation Interest in Abruzzo (Conti and Bartolucci 2012).

Tulipa pumila Moench (= *T. australis* Link)
Species with a Mediterranean-montane distribution (Pignatti 2017), very rare in Abruzzo where it is indicated for the Piano di Ovindoli (Pignatti 1982) and the Collelongo area (Conti and Bartolucci 2015). It is included in Category 1 (Extremely rare or endangered species, or species with a very small population, exclusive or at the limit of their distribution area and known for few point localities) in the List of Plants of Conservation Interest in Abruzzo (Conti and Bartolucci 2012).

Sanguisorba officinalis L.
Species quite rare in Abruzzo, indicated for a number of localities (Mauri et al. 1830; Tenore and Gussone 1842; Tammaro 1986, Pirone 1987a; Guarrera and Tammaro

1994; Buchwald 1995; Conti 1998). It is included in Category 3 (Rare or exclusive species, or species at the limit of their distribution area, not endangered, but sometimes in decline) in the List of Plants of Conservation Interest in Abruzzo (Conti and Bartolucci 2012).

Serratula tinctoria L. subsp. *tinctoria*
In Abruzzo, the species occurs on the Altipiani Maggiori, at Villavallelonga and Collelongo (Conti and Bartolucci 2015), Torricella Sicura and Vallaspra di Atessa (Conti and Pirone 1992) and in the Gran Sasso and Monti della Laga National Park (Conti and Bartolucci 2016).

The species is indicated as Vulnerable (VU) in the Regional Red List of Endangered Flora (Conti et al. 1997).

Conclusions

Phytosociological analysis of the meadow vegetation of the Altopiano delle Rocche high plateau led to identification of a new association, *Lathyro asphodeloidis-Klaseetum lycopifoliae*, currently known to be present exclusively between Rocca di Mezzo, Rocca di Cambio and Terranera on the Altopiano delle Rocche. With its own distinct floristic identity with respect to the other *Cynosurion* formations described, including at physiognomic level, the association has high biogeographic and conservation value for the presence of a number of species rare in Abruzzo and/or in Italy as a whole, above all in the *narcissetosum poëtici* subassociation, relating to the most widespread aspect occurring in the Le Prata area.

It is therefore to be hoped that in the future, the area, included in the Sirente-Velino Regional Park, will not be subjected to environmental disturbance or variations in forms of use which could compromise its conservation, and that, in addition to the LIFE project FLORANET (Di Martino et al. 2016) currently underway, the Park Authority implements the due monitoring measures in order to assess possible modifications over time in the extension and floristic composition of this very particular and unique plant community.

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Supplementary material 1

Study area, data analyses and pictures
Authors: Giampiero Ciaschetti, Gianfranco Pirone
Data type: multimedia
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Link: https://doi.org/10.3897/italianbotanist.7.33361.suppl1

Supplementary material 2

Relevés date and sporadic species
Authors: Giampiero Ciaschetti, Gianfranco Pirone
Data type: occurrence
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Link: https://doi.org/10.3897/italianbotanist.7.33361.suppl2